JUNIOR HIGH SCHOOL MATHEMATICS

CURRICULUM GUIDE

Alberta
EDUCATION
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ACKNOWLEDGEMENT

NOTE: THIS HANDBOOK IS A SERVICE PUBLICATION ONLY. The information
        is prescriptive only insofar as the content of the handbook
        duplicates that of the Junior High School Mathematics
        Program of Studies.

THE GOALS OF JUNIOR HIGH SCHOOL MATHEMATICS

The goals of junior high school mathematics are to develop skills of ordering, organizing, analyzing, and applying information in a critical and objective manner. More specifically the mathematics program should provide learning experiences specifically designed to enable students:

1. To acquire those basic mathematical skills and attitudes which are considered by society to be necessary for day to day life.

2. To become aware, through exploratory studies, of mathematics as a discipline and mathematics as a tool for use in a variety of practical "real life" situations, and,

3. To pursue further study of mathematics in preparation for lifelong learning, further formal study and/or employment.

The junior high school mathematics program has been established on the basis of the skills possessed by students graduating from elementary school and the needs which students have or will develop. It is very necessary for junior high school teachers to become familiar with the mathematics programs in grades five and six.

STRUCTURE OF THE PROGRAM

A. Core

The program as outlined in the Program of Studies is considered to be a description of a set of basic skills which all students should possess. It is intended that this program will constitute a minimum program for all students to master. It is assumed that above average students will have have their program enriched beyond the minimum program. Mastery of the minimum program is considered to be sufficient understanding of the concepts involved so that work in the subsequent grade level may proceed with no great problem.

The program for grades seven and eight is identified under six topical headings or strands. The grade nine course has two components. A core section and an elective section. The core is a continuation of the six strands
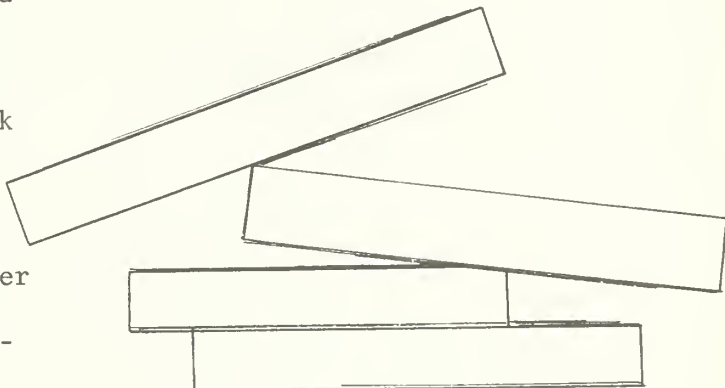
developed in grades seven and eight and the electives provide
opportunities for developing special mathematical interests. In
grade nine,concepts described in the six strands are compulsory but
the elective section is completely optional.

      Although the program is outlined according to topical strands,
it is not intended that the order of strands or the order within a
strand is or should be prescriptive. It is recognized that many topics
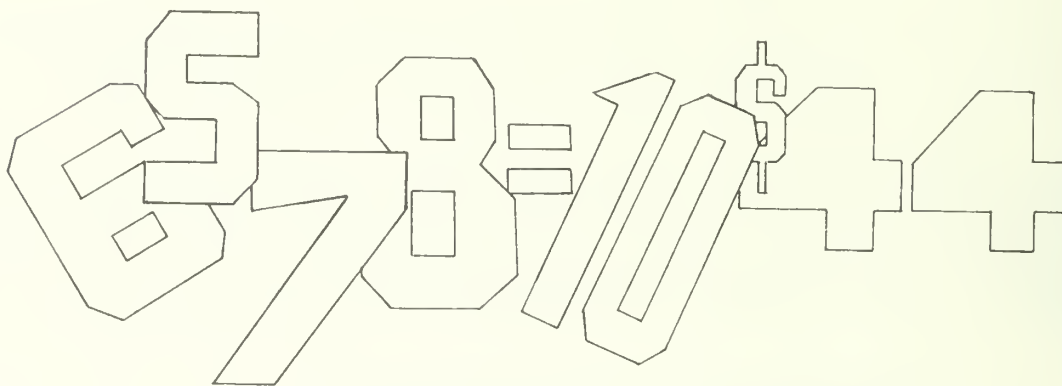may and should be taught as they relate to topics in other strands of
the program. The strands contained in the program are:

1. Number Systems
                a. Whole numbers
                b. Integers
                c. Rational Numbers

      The Number System strand is a combination of number concept
formation and operations and properties. Whole numbers have been
thoroughly developed in the elementary program, consequently most work
with whole numbers in junior high school is maintaining skills which
have been developed in elementary school. The only new topic in whole
numbers is in the area of exponents.

      While integers have been introduced in the elementary program,
it is expected that most students would benefit from a re-introduction
of the concept of integers in grade eight. Due to the added load of
teaching fractional numbers in junior high school, work with positive
and negative numbers at the grade eight level has been restricted to
integers.

      The category of rational numbers in the Junior High School
Program of Studies is intended to include positive and negative common
fractions, decimal fractions and integers. Decimal fractions without
sign have been extensively used in the elementary program. Common
fractions have been introduced in the elementary program and have been
studied in a conceptual sense and as they relate to decimal fractions.
Operations of common fractions are introduced in grade seven and form-
alized in grade eight. It is important to note that the intended
introduction of addition and subtraction of fractions in grade seven
be an informal approach dependent upon physical models.

As stated previously signed numbers in grade eight have been restricted to integers, therefore the grade nine program is the time in which the various number systems are related to each other at a formal level for any positive or negative rational number.

2. Ratio and Proportion

An intuitive approach to ratio and proportion is contained in the elementary program. Equivalent ratios have been compared through inspection. In Junior High ratios are related to percent in many practical situations such as interest, discount, commission and taxes. Ratios as examples of direct variation may lead to integration of this strand with the graphing strand.
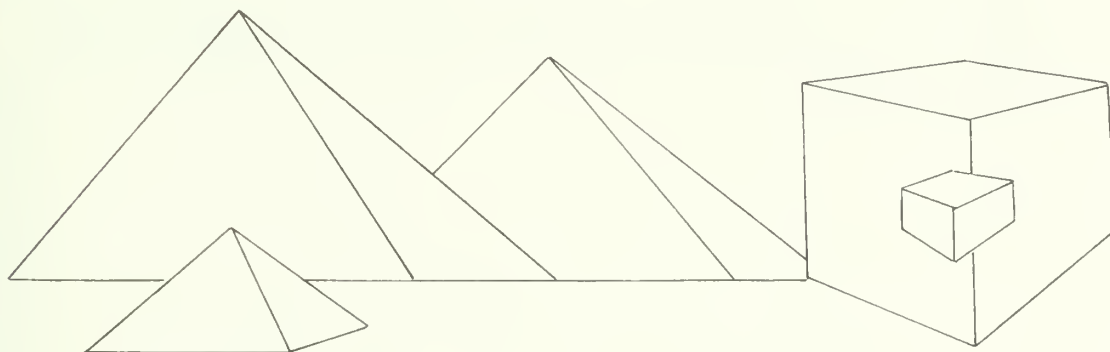
3. Measurement

The measurement strand is a continuation of the measurement strand in the elementary program. As such, much of the work in junior high school is maintaining and extending skills of measurement which were introduced in the elementary program. These skills include real life measuring experiences, estimations and applying formulae. Many of the skills to be maintained are done so in an identical manner as done previously, but with the expectation of greater precision.
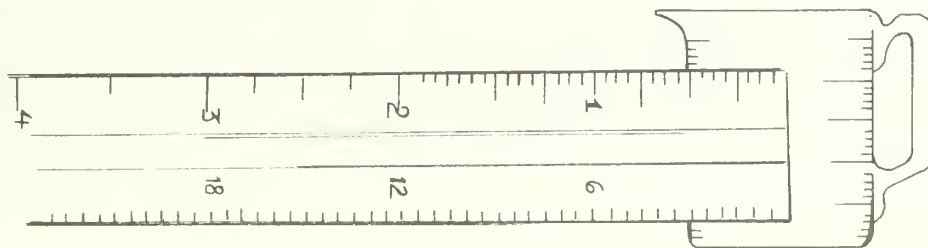
4. Geometry

Geometry in the elementary program consisted largely of recognizing attributes, ordering, and classifying objects in the real world and where possible, assigning quantitative or descriptive labels. The junior high program is again an extension of this development.

A portion of the geometry section in the elementary program is devoted to some basic motion geometry topics. Students should be familiar with translations, rotations, reflections and size transformations. These basic motions are used in grades seven and eight to investigate properties of two dimensional objects. Triangles may be classified by the number of lines of symmetry determined by the reflection transformation. To complement this, triangles can be given the same classifications according to the measures of the lengths of their sides.
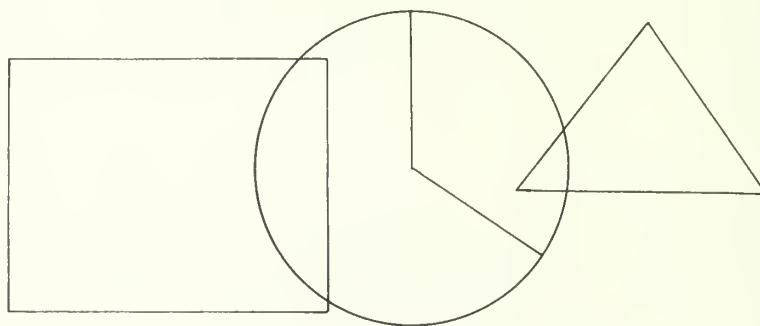
It is recommended that tracing paper, graph paper, mirrors, and a Mira (colored plexiglass) are valuable aids to the teaching of motion geometry topic.

Students probably learn best from personal involvement along with occasional demonstrations by the teacher. As students manipulate and construct both mathematical and physical models, properties, theorems and formulae are developed. The development of formulae is considered to be a geometry topic; the use of such formulae is considered to be a measurement topics.

5. Graphing

Most graphing done in the elementary program is a process of visually displaying data which has been organized according to some logical system. The data that is displayed quite often is quantitative and has been gathered by personal observation. Graphing in junior high school is more of the same, but in addition there is more emphasis on interpretations and graphs of functions.

Graphing provides an opportunity to integrate mathematics with other subject areas. The mathematics class is a good place to interpret graphs which have been constructed or used in other subject areas.
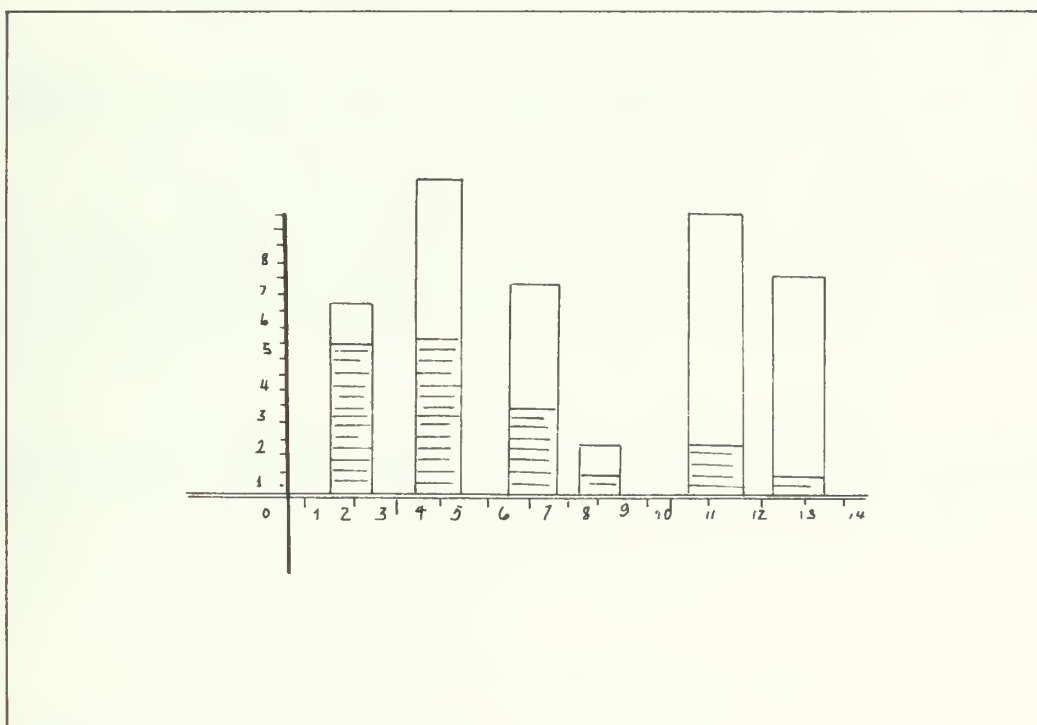
Graphing functions begin at grade seven; however, nothing formal is intended. When students graph points of a linear function they should be able to see a trend develop and conclude that these points do lie on a line. At the grade eight level students are expected to generate the ordered pairs if given the defining equations. Finally at the grade nine level students are expected to examine the defining equations and identify the role played by the dependent variable and the relation constant.

B. Electives

6. <u>Algebra</u>
          The algebra sections of the grade seven and eight
programs consist mainly of developing skill in solving equations. The
grade nine algebra strand is this and more. The introduction of poly-
nomials and some elementary operations and properties is also included.
It is quite probable that in addition to laying a foundation for grade
ten mathematics, the polynomial section may assist students to decide in
which mathematics course they should register in grade ten.

          In addition to the basic program in grade nine, elective
units have been made available as a service to teachers to assist in
dealing with individual differences. The less able student may
require the entire grade nine year to master the basic program. One
or more electives may be selected for study by the more able student
to fulfill goals such as increasing the level of appreciation for
skills, becoming aware of new fields of mathematics or learning to
order and apply mathematics with more precision in everyday situations.

          Teachers may select for study as many options as their
students are interested and capable of encountering. No options are
compulsory and the objectives and times listed under any topic heading
are suggestive rather than prescriptive.

APPLICATIONS AND PROBLEM SOLVING

There are no strands identified in the program as applications or problem solving. A distinction should be made between applications and the process of problem solving.

An application is the process of using a mathematical skill to arrive at a solution to a real life or practical situation. This aspect of mathematics is extremely important for all students to experience. In every strand the objective(s) which refers to word problems is suggesting that students should apply the skills learned to practical problems wherever possible. The students' degree of competence in the mathematical skill involved determines whether, and to what degree, problem solving is involved.

If the student knows immediately how to arrive at an answer to a problem then the process problem solving does not occur. The operation or manipulations involved are merely reinforcement of a mathematical skill. There is without question justification and need for assigning questions of this nature to students.

A given question which one student may solve with no hesitation, may present itself much differently to another student either because of lesser skill in mathematics or because the student has not encountered that "type" of question. Nevertheless, whenever hesitation occurs so that some deliberation is necessary before a method of solution is chosen, the process of problem solving is necessary.

Problem solving is the process involved whenever an individual encounters any situation where a desired solution is not immediately obvious. The situation may be very abstract as in pure mathematics, or it may be an application of a mathematical skill to a practical problem. One last dimension is that unsuccessful attempts at solving a situation do involve the process of problem solving.

The importance of problem solving in mathematics programs cannot be over emphasized. Since the beginning of this century problem solving has been the most popular topic for research investigation in elementary and junior high school mathematics.

The most common type of problem encountered in mathematics programs is usually referred to as a verbal problem of arithmetic. Very few educators would disagree that a verbal problem of arithmetic is a quantitative situation, the solution of which requires some reflective thought, an element of uncertainty and the use of at least one arithmetic operation.

During the period of reflective thought the individual:

1. attempts to understand the problem, and
2. tries to devise a plan for attacking the problem

The arithmetic operation is then carried out. The last step in the
problem solving process is a verification process in which the numerical
solution is judged to be correct or at least reasonable. The element
of uncertainty previously referred to does not disappear until the
verification stage is completed satisfactorily.

Much needs to be said about the mental processes which occur
during the period of reflective thought. Reflective thought begins
when an individual meets an unfamiliar situation and accepts the situation
as a challenge for which he desires a solution. The importance of one's
background and skill in mathematical operations is obvious if an
unfamiliar situation is encountered. During all reflective thought
processes previous experiences are being constantly related and compared
to. He then analyzes the problem and states the problem, either mentally,
verbally or diagramatically, in his own terms. The thought then turns
to a search for leads and tentative hypotheses. The cycle of framing
and testing hypotheses until a method of solution is reached is the
heart of problem-solving. After the solution has been verified a good
problem solver will organize the solution of the problem into some
frame of references so that the skill as a problem solver may ever
increase.

A very good question, on which there are various opinions, is
whether you can actually teach a process of problem solving or whether
the process is something that simply develops or matures. Many research
studies have been devoted to this specific topic and the following is a
list of helpful suggestions arising from these studies:

1. The teacher needs to see that children are given many
   opportunities to solve problems.

2. Students should be allowed to solve problems in
   various ways.

3. Mastery of the four fundamental arithmetic processes
   is a necessary condition for acquiring skill as a
   problem solver.

4. There seems to be no one method of teaching which is
   best for all students.

5. Teachers must challenge problem solutions more often
   because many students get the right answer without
   understanding the problem.

6. Relative to #5, teachers should use extraneous materials and compel students to justify methods by concrete examples.

7. Problem solving lessons should be structured with multilevel difficulties.

8. Problem solving lessons should include situations related to the learner's environment and those quite foreign to him (from history books or other societies).

9. The trial and error method of problem solving is widely used when very difficult problems are encountered. Teachers should teach the intelligent use of this method.

PATTERNS

Although only a few objectives in the Junior High Mathematics Program mention patterns, one cannot teach number systems, graphing or problem solving without being aware of patterns in mathematics. Mathematics is an orderly system and as such possesses patterns, some of which probably have not yet been discovered. Students should be encouraged at all times to be aware of and look for patterns. Many properties of mathematics may be discovered or finally understood through patterns in algebra, numbers, shapes or statistics.

GRADE 5	GRADE 6	GRADE 7
Rounds whole numbers. (Limit: 5-digit accuracy). Rounds to tenths and hundredths.	Rounds numerals to required accuracy including thousandths.	
		Understands that division by zero is undefined. Evaluates an expression by using properties to produce short cuts in the computation. (Limit: Commutative, Associative, Distributive.) eg. 4 x 23 x 25 = n 100 x 23 = n Understands the basis of the distributive property.
		Recognizes prime numbers to 50. Determines whether a number is divisible by 2, 3, 5 or 9. Lists the set of factors for whole numbers (Limit 200). Expresses a number as a product of factors.
Identifies and uses place value of digits (0.001 - 999 999). Expresses tenths, hundredths, and thousandths as fractions or decimals.	Identifies place value to billions (0.0001 - 1 000 000 000) Expresses halves, quarters and fifths as fractions or decimals.	Demonstrates the need for fractional numbers using concrete examples. eg. A 5-metre board is cut into 4 pieces of equal length. What is their length? (4x = 5)
	Identifies and orders integers.	Uses the divided unit as a number line to order rationals. Demonstrates knowledge of the fractional numbers by plotting a given set on a number line.

SYSTEMS

GRADE 8	GRADE 9
Demonstrates the use of identity elements and the zero property. States the multiplication inverse of any integer other than zero. Evaluates integral expressions by using the properties to produce short cuts in the computation (Limit: Commutative, Associative, Distributive). eg. $-6\ ^+4 + \ ^+6 = n$ $\quad (-6 + \ ^+6) \ + \ ^+4 = n$ $\quad\quad 0 + \ ^+4 = n$	
	Expresses a number as a product of factors (including prime factorization).
Demonstrates the need for integers. Develops the integers using whole numbers and directed segments. Demonstrates the need for rational numbers. eg. $-5 \div 2 = x$, closure property Recognizes rational numbers as all numbers which may be expressed in the form $\frac{a}{b}$, $b \neq 0$, or as infinite repeating decimals.	Maintains previously developed skills. Recognizes a need for negative rationals.
Compares the whole numbers and integers by plotting both sets on a number line. Demonstrates the relationship between integers, whole numbers, and fractionals. Compares the rational numbers and integers using a number line. Orders integral expressions by using $<$, $>$ or $=$. Orders rational numbers using $>$, $<$ or $=$.	Estimates square roots of numbers. Uses tables to determine the square root of a number.

GRADE 5	GRADE 6	GRADE 7
Adds and subtracts whole numbers.	Adds and subtracts whole numbers.	Maintains all previously developed skills and ideas; uses symbols and notation illustrated below:
Multiplies whole numbers using one, two, and three digit multipliers.	Multiplies using one, two and three digit multipliers.	a. Multiplication i. $3 \times 4 = 3(4)$ ii. $3x = 3.x$
	Checks multiplication by division and division by multiplication.	b. Division i. $\frac{9}{3} = 9 \div 3 = 3\overline{)9}$ ii. $\frac{x}{9} = x \div 9 = 9\overline{)x}$
Divides whole numbers using one and two digit divisors (with and without remainders).	Divides using one, two and three digit divisors (with or without remainders).	
Demonstrates mastery of basic facts.	Demonstrates mastery of basic facts.	Evaluates expressions involving the order of operations; expressions of the type: $7 + 5 - 4 \times 3 + 1$
		Writes equivalent fractions and can determine whether fractions are equivalent.
		Reduces any fraction to its basic form (limit 2-digit denominator).
		Divides concrete objects into halves, quarters, eighths, sixteenths and thirds, sixths, twelfths.
		Using concrete materials as measures, adds and subtracts fractions.
		Performs the operations of addition and subtraction with proper fractional numbers. Emphasis on denominators such as halves, quarters, fifths and tenths.
Estimates products and quotients. Adds, subtracts and multiplies decimals to thousandths.	Mentally computes simple addition, subtraction, multiplication and division problems. Multiplies and divides decimals.	Using a divided unit, measures something larger than the unit. Uses the fraction symbol $\frac{a}{b}$, mixed numerals and decimal notation to denote the measure.
		Converts mixed numbers to improper fractions and vice versa
		Converts fractions to decimals and vice versa with emphasis on tenths, hundredths, thousandths, halves, quarters and fifths.
		Maintains previously developed skills and ideas using decimals. (Particularly multiplication and division of powers of 10.)
Solves word problems. Estimates answers.	Solves word problems. Estimates answers.	Writes mathematical sentences for English sentences.
		Solves word problems which can be solved by addition, subtraction, multiplication or division using whole numbers.
		Solves word problems that contain extraneous information. (imit - whole numbers.)
		Solves word problems involving decimals.
		Identifies patterns or order in number arrangements such as addition tables, multiplication tables, or series of numbers.
	Writes decimal numerals using expanded notation.	

GRADE 8	GRADE 9
Maintains previously developed skills: computation with fractional and decimal numerals. States the additive inverse of any integer. Performs the operations of addition, subtraction, multiplication, and division with positive rational numbers using algorithms. Performs the operations of addition, subtraction, multiplication and division with integers.	Simplifies expressions involving the order of operations. (four arithmetic operations and powers.) Writes positive or negative rationals in lowest terms or higher terms. Maintains previously developed skills. Adds, subtracts, multiplies and divides positive or negative rational numbers.
Writes mathematical sentences for English sentences. Solves word problems which can be solved by addition, subtraction, multiplication or division. (Limit integers and positive rational numbers.) Maintains previously developed skills in problem solving. Solves word problems that contain extraneous information. The student will illustrate an appreciation for numbers by working on pattern problems. Given sets of data, the students will find patterns which are functions.	Solves problems involving positive and/or negative rationals (emphasis on decimals). Maintains previously developed skills in problem solving. Estimates products and quotients to determine if an answer is reasonable.
Understands and uses the terms exponent, base, power, squared, cubed, and to the nth power. Understands and uses the following properties: a. $a^x \cdot a^y = a^{x+y}$ b. $a^x \div a^y = a^{x-y}$ Writes numbers in various forms: a. expanded form of whole numbers using exponential notation, b. writes whole numbers in scientific notation. Writes the values for powers. (Whole number bases and exponents.)	Writes the values for powers (whole number exponents). Understands and uses the following properties: a. $(a^x)^y = a^{xy}$ c. $a^o = 1$, $a \neq o$ b. $a^{-x} = \dfrac{1}{a^x}$ Writes any number in scientific notation and vice-versa. Changes positive or negative rationals in the form $\dfrac{a}{b}$, $b \neq 0$ to decimals. Changes rational numbers in decimal form to the form $\dfrac{a}{b}$.

GRADE 5	GRADE 6	GRADE 7
Expresses and generates proportional ratios.	Identifies applications of proportional ratios.	Writes ratios. Writes equivalent ratios.
Solves for the missing numeral in proportional ratios without using cross-products.	Uses decimal fractions to express and solve for percent.	Uses equivalent ratios to solve for the unknown numerator or denominator. Converts ratios to percents.
		Solves word problems involving ratios. Solves percent problems using proportions: a. solves for percent; b. having percent, solves for the unknown quantity.

PROPORTION

GRADE 8	GRADE 9
Maintains previously developed skills.	Maintains previously developed skills.
Converts decimals to percents. Converts percents to decimals or common fractions.	
Solves word problems involving simple interest, commission, sales tax, and single discount. Solves word problems involving percent of increase or decrease.	Uses ratios to solve problems involving: a. percentages, b. distance, speed and time, c. profit, interest, commission, tax, discount, premiums. Uses ratios to construct scale drawings.

GRADE 5	GRADE 6	GRADE 7
Reads and writes time to seconds. Reads the 24 hour clock.	Reads the 24 hour clock and writes corresponding time notation.	

Extends use of standard unit to include tonnes.
 	
Uses appropriate standardized measuring units.
 	
Understands the system of metric prefixes, including use of symbols.
kilo
  hecto
    deca Basic Unit
         deci -
-centi
   milli
		Demonstrates that previous skills are being maintained.
		
		Performs the four basic operations in SI units.
		
		Estimates the measure of various objects (linear, capacity, mass) in SI Units.

Finds perimeter of polygons without using formulas. Finds area of regular polygons without using formulas. Finds volume of rectangular solids without using formulas.	Knows interrelationships among units of length, capacity, and mass. Finds perimeter of polygons with and without formulas. Finds area of triangles and quadrilaterals using formulas. Finds volume of rectangular solids using formulas.	Calculates perimeters of polygons with or without a formula. Calculates areas of triangles, rectangles and parallelograms.
Draws 2-D figures to scale using grid paper. Expresses equivalent measures within units of length, mass and capacity. eg. 1 m + 4 dm + 2 cm = 1.42 m, 14.2 dm, or 142 cm	Reads distances according to a scale. Draws diagrams according to a scale.	Solves problems using measuring instruments (ruler, scales) Constructs diagrams completely labelled with relevant numbers or measures.
		Estimates the size of a given angle within limits specified by the teacher. Constructs selected angles using protractor, compass, or Mira (to 180°) as directed by the teacher. Writes mathematical sentences for English sentences. Solves word problems which can be solved by addition, subtraction, multiplication, or division. Solves word problems that contain extraneous information.

MENT

GRADE 8	GRADE 9
Demonstrates previous skills are being maintained. Extends knowledge of area to hectare and expresses area using proper symbols. Uses the appropriate SI unit in area measurement and demonstrates the interrelatedness of one unit to another.	Demonstrates that previous skills are maintained.
Calculates the perimeter of polygons using a formula. Calculates the area of triangles and quadrilaterals using a formula. Develops facility in area measurement using SI units cm^2, m^2. Develops and uses formulas to calculate circumference and area of circles using appropriate SI units. Uses the appropriate SI unit and symbol when measuring and expressing volume. Understands the interrelatedness of volume units cm^3 through m^3.	Calculates surface areas (SI units) of prisms and cylinders using formulas. Calculates the area of regular polygons.
Solves word problems involving situations described in SI units. (Students should be encouraged to draw diagrams and estimate.)	

GRADE 5	GRADE 6	GRADE 7
Identifies radius, diameter and circumference. Names corresponding sides and angles of congruent polygons. Distinguishes 2-dimensional figures as similar or congruent.	Identifies and names lines, line segments, rays, inter-secting lines, parallel lines, perpendicular lines.	Maintains previously developed skills. Identifies diagonals of polygons. Identifies altitudes of triangles and quadrilaterals. Identifies and classifies angles according to their measu Classifies polygons according to the number of sides. Generates a perimeter formula for any regular polygon.
		Identifies and classifies triangles with respect to: - measures of sides - measures of angles - lines of symmetry
Tests congruency of polygons using motion geometry (slides, flips and turns).	Translates, rotates, reflects, and enlarges 2-dimensional figures.	Determines the angle sum of triangles.
		Represents a translation by a slide arrow, a reflection by a reflection line, and a rotation by a turn center and turn arrow. Creates and discusses simple repeated patterns in terms of translations (slides) reflections (flips) or rotations (turns). Constructs the image of a figure given a combination of transformations (translations,reflections, rotations). Given congruent figures on geopaper, names the trans-formation or combination of transformations that move one figure on to the other.
	Constructs 3-dimensional objects.	Constructs polygons using protractor and straight edge, compass and straight edge or Mira, as specified by the teacher. Draws patterns and designs using compass only.

ETRY

GRADE 8	GRADE 9
Maintains previously developed skills. Identifies pairs of angles: supplementary, complementary, corresponding, linear, opposite and adjacent. Identifies and classifies polygons. Generates an area formula for specified quadrilaterals (parallelogram, rectangle, square).	Demonstrates that previous skills are being maintained. Uses such terms as edges, faces, lateral face, base, height, slant height, in examining prisms, pyramids and other polyhedra. Classifies right prisms, right pyramids, given models of various types. Develops, with assistance, formulas to measure volume and surface area of right prisms, and cylinders. Given word problems or diagrams and formulas the student will solve volume and surface area problems.

Identifies and classifies quadrilaterals by examining relationships between:
  - lines of symmetry
  - parallel sides
  - measures of angles
  - measures of sides.	

	Demonstrates knowledge of the Theorem of Pythagoras through an ability to solve problems.
Uses slide notation to describe various translations (slides) 3R, 2D, for 3 right and 2 down. Describes translations using ordered pairs. eg. (+3, -2) for 3 to right, 2 down. Obtains the rotation image for any polygon.	
Uses compass and straight edge to construct angles. Uses compass and straight edge to bisect angles, construct perpendicular bisectors, and to construct specified angles. (90°, 45°, 60°, 30°) 'Constructs perpendiculars, bisectors, specified angles and bisects angles using reflections.	Using compass and straight edge, constructs triangles congruent to given triangles, using SSS, SAS, and ASA. Constructs regular polygons. Constructs models of right prisms, right pyramids or regular polyhedra as specified by the teacher.

GRADE 5	GRADE 6	GRADE 7
Constructs line, bar and pictographs.		Constructs line graphs and bar graphs.
Interprets and solves problems using data collected from line, bar and pictographs.		Reads, interprets and applies information from pictographs line graphs, or circle graphs. eg. State the height after 3 seconds; when is the difference between A and B greatest? (If the trend continues, what will be the population of Canada in 1999?)
	Locates points in all four quadrants.	
Reads and writes co-ordinates from a graph. Generates ordered pairs from a given relationship. Graphs ordered pairs from given relationships.	Generates ordered pairs from a given relationship involving integers.	Graphs points of a linear function, given the ordered pairs, and notes that these points lie on a line. Given a number and a procedure, the student will be able to give the second element with which the number is paired - in numerical settings. - in practical settings (postage, packaging, distance a bicycle travels, etc.)

HING

GRADE 8	GRADE 9
Constructs circle graphs.	
	Pictures square roots of numbers graphically and reads approximate roots of non-perfect squares from the graph.
Locates any point defined by an ordered pair of integers. (In all four quadrants.)	
Generates a set of ordered pairs in a linear function given the defining equations. Graphs points of a linear function given ordered pairs of integers and notes that those points lie on a line.	Makes graphs from mathematical data and recognizes the dependent variable and the rélation constant (limited to linear relations).

A L G E

GRADE 5	GRADE 6	GRADE 7
		Verifies solutions of conditions (equations) by substitution.
		Solves the following types of conditions (equations) involving whole numbers or decimals: a. a + x = b b. ax = b c. ax + bx = c
		Evaluates expressions by substituting for the variables (use whole numbers and decimals).

BRA

GRADE 8	GRADE 9
Solves the following types o. conditions (equations), in which the solution does not involve computation with negative fractional numbers. a. $a + x = b$ b. $ax = b$ c. $ax + b = c$ d. $\frac{x}{a} = \frac{b}{c}$ e. $ax + bx = c$	Solves any first degree equation in one variable with rational coefficients.
Evaluates expressions by substituting for the variables. (Using whole numbers, fractions, decimals, integers, and rationals).	Knows that letters represent variables.
Writes mathematical sentences for English sentences describing real life or abstract number relationships.	Writes word problems for given mathematical statements. Translates English expressions into algebraic expressions.
Solves word problems involving abstract number relationships.	Solves a variety of problems by writing an equation in one variable and solving same. Solves problems which require the use of a formula. Knows that formulas represent rules or definitions that express a relation between variables in mathematics and/or science. Interprets mathematical data and can express it as a relationship (limited to linear relations using a non-formal approach). Applies mathematical principles of variation and formulas to real situations. Predicts the effect of altering specific elements of a formula. Identifies specific algebraic terminology; constants, variables, terms and factors in an expression. Evaluates expressions by performing the operations in correct order. Classifies polynomials as to monomial, binomial and trinomial. States the degree of a polynomial and writes the polynomial in standard form. Identifies the numerical coefficient of a monomial. Identifies "like" and "unlike" terms and is able to combine like terms. Finds the sum and difference of polynomials by re-ordering the elements. Finds the products and quotients of monomials. Finds the product of a monomial and a polynomial. Factors a polynomial by taking out the greatest common factor. Finds the product of binomials. Factors trinomial ax^2+bx+c, where $a=1$.

TEXTS AND REFERENCES

<u>PRESCRIBED TEXTS</u>:

<u>Grade 7</u>:

Ebos, Frank, et al, *Math Is 1*,
    Don Mills: Thomas Nelson & Sons, 1975

Elliott, H. A. et al, *Holt Mathematics 1*,
    Toronto: Holt, Rinehart & Winston, 1976

Fleenor, Charles R. et al, *School Math 1*,
    Don Mills: Addison-Wesley, 1974

<u>Grade 8</u>:

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    Don Mills: Thomas Nelson & Sons, 1975

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<u>Grade 9</u>:

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Elliott, H. A. et al, *Holt Mathematics 3*,
    Toronto: Holt, Rinehart & Winston, 1978

Krysak, Walter P. et al, *Math Probe 1*,
    Toronto: Holt, Rinehart & Winston, 1976

<u>SUPPLEMENTARY REFERENCES</u>:

1. *Junior High School Mathematics Consortium* material
    for Grades 7, 8 and 9.

    1. Management and Audiovisual Guide 7, 8, 9
    2. Cross Reference Manual 7, 8, 9
    3. Basic Skills Supplement 7, 8, 9
    4. Teacher's Resource Books (A and B) for each of
        Grades 7, 8 & 9
    5. Transparency Masters 9
    6. Student Exercise Books (A and B) for each of
        Grades 7, 8 & 9

2. Addison-Wesley *School Math I & II*

        Evaluation Program (1977) for *School Math I & II*

        Duplicator Masters 1977 for *School Math I & II*

COURSE OUTLINE

Grade 7

1. NUMBER SYSTEMS	TEXT REFERENCE		
A. __WHOLE NUMBERS__	*Math Is 1*	*Holt Math 1*	*School Math 1*

1. Maintains all previously developed skills and ideas; uses symbols and notation illustrated below:
 	
a. Multiplication
 	
  i. $3 \times 4 = 3(4)$
 	
  ii. $3x = 3 \cdot x$
 	
b. Division
 	
  i. $\frac{9}{3} = 9 \div 3 = 3\overline{)9}$
 	
  ii. $\frac{x}{9} = x \div 9 = 9\overline{)x}$
	3,6, 9-12, 56, 57	6,7,13,14, 15,16,18, 19,20-23, 40-41	A46,A47

2. Understands the basis of the distributive property.	22,23	183	A40,A41
3. Evaluates an expression by using properties to produce short cuts in the computation. (Limit: Commutative, Associative, Distributive). eg. $4 \times 23 \times 25 = n$ $100 \times 23 = n$	22,23	176,181-182	A38-A41 A48
4. Evaluates expressions involving the order of operations; expressions of the type: $7 + 5 - 4 \times 3 + 1$	12-14, 86,87, 235,236	32,33, 41	A36-A41
5. Writes mathematical sentences for English sentences.	244-246	36,37,165	A61,A65
6. Solves word problems which can be solved by addition, subtraction, multiplication or division,using whole numbers.	3-5, 247	17,21,36, 37,190, 191	A43-A45, A49, A70-A73

		TEXT REFERENCE	
Number Systems (Continued)	Math Is 1	Holt Math 1	School Math 1
7. Solves word problems that contain extraneous information. (limit to whole numbers).			A66,A67
8. Recognizes prime numbers to 50.	18	24,30,31	A82-A83
9. Lists the set of factors for whole numbers. (Limit 200.)	18	24,25,41	A81 A85,A89
10. Expresses a number as a product of factors.	17-19	26,27,41	A80, A84 A81,A85
11. Determines whether a number is divisible by 2, 3, 5 or 9.	141	30,31	E76 Gr.8
12. Understands that division by zero is undefined.		235	A38
13. Identifies patterns or order in number arrangements such as addition tables, multiplication tables, or series of numbers.	59,278	16,21,27 192,193	A28,A35 B23,B29

B. RATIONAL NUMBERS

	Math Is 1	Holt Math 1	School Math 1
1. Maintains previously developed skills and ideas using decimals. (Particularly multiplication and division of powers of 10.)	61-69 71-74 78-84	97-100 102,103, 109-118 265	B66,B74-B79 B67,B82 B70,B83 B71
2. Demonstrates the need for fractional numbers using concrete examples. eg. a 5-metre board is cut into 4 pieces of equal length. What is their length? (4x = 5)	27-30		B2 B3 B85
3. Uses the divided unit as a number line to order rationals.	28	243	B12-B15
4. Demonstrates knowledge of the fractional numbers by plotting a given set on a number line.	28	245	B8 B9

	TEXT REFERENCE		
Rational Numbers (Continued)	*Math Is 1*	*Holt Math 1*	*School Math 1*
5. Divides concrete objects into halves, quarters, eighths, sixteenths and thirds, sixths, twelfths.	29	72-74	B2 B3
6. Using a divided unit, measures something larger than the unit. Uses the fraction symbol $\frac{a}{b}$, mixed numerals and decimal notation to denote the measure.			C38 C39
7. Writes equivalent fractions and can determine whether fractions are equivalent.	31-33	71	B4, B10 B5, B11
8. Reduces any fraction to its basic form. (Limit 2-digit denominator)	33,34		B6, B7
9. Converts fractions to decimals and vice versa with emphasis on tenths, hundredths, thousandths, halves, quarters and fifths.	77,78	101,105, 106,107	B86 B91
10. Converts mixed numbers to improper fractions and vice versa.	39		B26 B27
11. Using concrete materials as measures, adds and subtracts fractions.			
12. Performs the operations of addition and subtraction with proper fractional numbers. Emphasis on denominators such as halves, quarters, fifths and tenths.	38-43	72-76	B22, B23, B28, B29
13. Solves word problems involving decimals.	69,70,76 80,103	37,103,104 105,115,118 269,273,275 276	B73, B84 B75 B80
14. Solves word problems that contain extraneous information.			

2. RATIO AND PROPORTION	TEXT REFERENCE		
	Math Is 1	Holt Math 1	School Math 1
1. Writes ratios.	170-176 181	90,252	B98 B99
2. Writes equivalent ratios.	176-179 181 183-185	90,91 250,251 253	B100 B101
3. Uses equivalent ratios to solve for the unknown numerator or denominator.	186	91,92	B87 B102 B103
4. Solves word problems involving ratios.	98,99 186-193	93,284	B103,B106 B107,B114
5. Converts ratios to percents.	203-206	119,120 283	B108,B109
6. Solves percent problems using proportions a. solves for percent; b. having percent, solves for the unknown quantity.	204-212	121 284 285	B110-B113 B120 B121

3. MEASUREMENT			
1. Demonstrates that previous skills are being maintained.	74-75 120 121-126	44,45	B72 B73 C36-C39
2. Estimates the measure of various objects (linear, capacity, mass) in SI Units.	125,126	46,47 49,50	C38
3. Solves problems using measuring instruments (ruler, scales).		43,44,47	B30 B85 B95
4. Constructs selected angles using protractor, compass, or Mira (to 180°) as directed by the teacher.	150	66	C58,C59 C92,C93 C96
5. Estimates the size of a given angle within limits specified by the teacher.	146,149	66	G38 Gr.9

	TEXT REFERENCE		
Measurement (Continued)	Math Is 1	Holt Math 1	School Math 1
6. Writes mathematical sentences for English sentences.			C47 C57
7. Performs the four basic operations in SI units.	128,129 130-133	48,49 51-55	B73,B93, B75,B106 B76,B107 C47-C49
8. Calculates perimeters of polygons with or without a formula.	84, 127-129	51,52,53	C40,C41
9. Calculates areas of triangles, rectangles, and parallelograms.	130-133 269, 271-273	53-57	C44-C49
10. Solves word problems which can be solved by addition, subtraction, multiplication, or division.	86,131 273,137 248,249	59,63-65 103,118 253	B73 B103
11. Solves word problems that contain extraneous information.			
12. Constructs diagrams completely labelled with relevant numbers or measures.	248	55	A70-A71

4. GEOMETRY			
1. Maintains previously developed skills.	111,260	127,128	C16 C17
2. Creates and discusses simple repeated patterns in terms of translations (slides), reflections (flips), or rotations (turns).	279-288	223,226 227,230 231	C82,C83
3. Draws patterns and designs using compass only.	114-118	134,135 210-212	C95,C103
4. Constructs polygons using protractor and straight-edge, compass and straight-edge or Mira, as specified by the teacher.	159	215,216 217,319	C94,C95 C102,C103

	TEXT REFERENCE		
Geometry (Continued)	*Math Is 1*	*Holt Math 1*	*School Math 1*
5. Identifies altitudes of triangles and quadrilaterals.	269		C48,C49
6. Identifies diagonals of polygons.	272,160		C30,C31
7. Constructs the image of a figure given a combination of transformations (translations, reflections, rotations).		224,225 228,229	C72,C73 C80,C81
8. Given congruent figures on geopaper, names the transformation or combination of transformations that move one figure on to the other.	288	223,224 229	C70,C71 C74,C75 C78,C79
9. Represents a translation by a slide arrow, a reflection by a reflection line, and a rotation by a turn center and turn arrow.	280-288	223,226	C72-C74
10. Classifies polygons according to the number of sides.	159	131,138	C30 C31
11. Identifies and classifies angles according to their measure.	147	66,67	C20 C21
12. Identifies and classifies triangles with respect to: - measures of sides - measures of angles - lines of symmetry	152-155	131,132 213,218	C24 C25
13. Determines the angle sum of triangles.	261	66	C62
14. Generates a perimeter formula for any regular polygon.			C40

5. GRAPHING	TEXT REFERENCE		
	Math Is 1	Holt Math 1	School Math 1
1. Given a number and a procedure, the student will be able to give the second element with which the number is paired. - in numerical settings. - in practical settings (postage, packaging, distance a bicycle travels, etc.)	16	175,176	B32-B35
2. Graphs points of a linear function, given the ordered pairs, and notes that these points lie on a line.	274,275	173,174,175 176,248 276,277	B32 B33
3. Reads, interprets and applies information from pictographs, line graphs, or circle graphs. eg. State the height after 3 seconds; when is the difference between A and B greatest? (If the trend continues, what will be the population of Canada in 1999?)	220-229	38,39 247	D48-D53
4. Constructs line graphs and bar graphs.	227,230	38,39,41 47,65,247 270,271	D46-D51

6. ALGEBRA			
1. Evaluates expressions by substituting for the variables (use whole numbers and decimals).	15,16 236,237	34,35	A60,A61
2. Solves the following types of conditions (equations) involving whole numbers or decimals: a. $a + x = b$ b. $ax = b$ c. $ax + bx = c$	42, 243	35,41 315,317	A60 A64 A65
3. Verifies solutions of conditions (equations) by substitution.	242		A64

Grade 8

1. NUMBER SYSTEMS	TEXT REFERENCE		
A. WHOLE NUMBERS	*Math Is 2*	*Holt Math 2*	*School Math 2*
1. Understands and uses the terms exponent, base, power, squared, cubed, and to the nth power.	2,19,20	226	E10 E11
2. Understands and uses the following properties: a. $a^x \cdot a^y = a^{x+y}$ b. $a^x \div a^y = a^{x-y}$		227-230	E11
3. Writes numbers in various forms: a. expanded form of whole numbers using exponential notation, b. writes whole numbers in scientific notation.	22,24,25 251,252 253	228 230-232	E5,E11 F38-F41 F48,F49
4. Writes the values for powers. (Whole number bases and exponents.)	3	226,227 233,234	E11
5. Maintains previously developed skills in problem solving.	4,6,7 43,44	20-23	E14,E15 F22 F29
6. Given sets of data, the students will find patterns which are functions.	32-33 112-119	227,228 234,235	E80 E81

B. INTEGERS

1. Demonstrates the need for integers.	211	84	E90
2. Develops the integers using whole numbers and directed segments.	211,212,218	84,85	E90,E91
3. Compares the whole numbers and integers by plotting both sets on a number line.	211	345,84	E90

		TEXT REFERENCE		
Integers (Continued)		Math Is 2	Holt Math 2	School Math 2
4.	Demonstrates the use of identity elements and the zero property.	303	97, 88-90	E94 E95
5.	States the additive inverse of any integer.	220	88	E91
6.	Performs the operations of addition, subtraction, multiplication and division with integers.	217-223, 227,228 230-238 240-242	86-95	E92- E105
7.	States the multiplication inverse of any integer other than zero.		262	F20, F21
8.	Evaluates integral expressions by using the properties to produce short cuts in the computation (limit: Commutative, Associative, Distributive). eg. $-6 + {}^+4 + {}^+6 = n$ $(-6 + {}^+6) + {}^+4 = n$ $0 + {}^+4 = n$		83,96 100	E95
9.	Orders integral expressions by using $<$, $>$, or $=$.	211,213,216	84,85	E108 E109
10.	Demonstrates the relationship between integers, whole numbers, and fractionals.	215,303	345 115	
11.	Writes mathematical sentences for English sentences.	256-259	34,35,37	E93
12.	Solves word problems which can be solved by addition, subtraction multiplication or division (limit to integers).	222,223,229 244-246,255 256,257	97,37 Gr.7 300-303	E93
13.	Solves word problems that contain extraneous information.			
14.	Locates any point defined by an ordered pair of integers. (In all four quadrants.)	224-227	252 G4.7 310-315	F32,F33
15.	The student will illustrate an appreciation for numbers by working on pattern problems.	21,32,33 232,235	92,93 254	E9,E66,E67 E80-E85 E97,E128

	TEXT REFERENCE		
C. RATIONALS	*Math Is 2*	*Holt Math 2*	*School Math 2*
1. Maintains previously developed skills: computation with fractional and decimal numerals.	14-16, 22-26, 28, 33-40	98-107 116	F2-F5,F42 F43,F52-F55 F64
2. Performs the operations of addition, subtraction, multiplication, and division with positive rational numbers using algorithms.	16 47-58	108-119	Gr.7 Bk B22-B29 B40-B55
3. Demonstrates the need for rational numbers. eg. -5 ÷ 2 = x, closure property.	215	345	F6,F7
4. Recognizes rational numbers as all numbers which may be expressed in the form $\frac{a}{b}$, b≠0, or as infinite repeating decimals.		26,104, 345	B88,B89 G4.7 F60,F61 Gr.8
5. Compares the rational numbers and integers using a number line.	215	345	
6. Orders rational numbers using >, <, or = .	216	345	F26,F27 (Grd.8) B12-B15 (Grd.7)
7. Writes mathematical sentences for English sentences.	258-260		
8. Solves word problems which can be solved by addition, subtraction, multiplication, or division (limit to positive rationals).	59	354	F28,F29
9. Solves problems that contain extraneous information.			

2. RATIO AND PROPORTION	TEXT REFERENCE		
	Math Is 2	Holt Math 2	School Math 2
1. Maintains previously developed skills.	175-178, 185,186	121-123, 146,147	F68-F73
2. Converts decimals to percents.	51-52, 192-196	125	F80,F81
3. Converts percents to decimals or common fractions.	192-196	125	F82
4. Solves word problems involving simple interest, commission, sales tax, and single discount.	197-202	126-131	F83-F87
5. Solves word problems involving percent of increase or decrease.		127-136	F88-F91

3. MEASUREMENT			
1. Demonstrates previous skills are being maintained.	62-67 140-142	51,52,65	G30-G33 G38
2. Develops facility in area measurement using SI units cm^2, m^2.	70,76,78 97-99	64,65 55,56	G34-G37
3. Uses the appropriate SI unit in area measurement and demonstrates the interrelatedness of one unit to another.	26-29 65-67 216	47,48,56	
4. Calculates the perimeter of polygons using a formula.	69 266-268	52,53,55	
5. Calculates the area of triangles and quadrilaterals using a formula.	68,69,70 76,78	55-58	G34-G37
6. Extends knowledge of area to hectare and expresses area using proper symbols.	Gr.7 p.121 98	47	
7. Uses the appropriate SI unit and symbol when measuring and expressing volume.	27,28	47,48,59 60,65	G46,G48
8. Understands the interrelatedness of volume units cm^3 through m^3.	27	47,48 59,60	G46

		TEXT REFERENCE		
Measurement (Continued)		*Math Is 2*	*Holt Math 2*	*School Math 2*
9.	Develops and uses formulas to calculate circumference and area of circles using appropriate SI units.	91-99	53,54 57,58	G80-G85
10.	Solves word problems involving situations described in SI units. (Students should be encouraged to draw diagrams and estimate.)	71,73 94,95 98,99,107	58,65	G35 G86

4. GEOMETRY				
1.	Maintains previously developed skills.	140-150 166,167	151-154	G2,G3 G8,G9
2.	Uses compass and straight-edge to construct angles.	156,157	171	Gr.7 (C92 C93)
3.	Uses compass and straight-edge to bisect angles, construct perpendicular bisectors, and to construct specified angles. (90°, 45°, 60°, 30°)	158,159 161,164	170-173	Gr.7 (C96, C97)
4.	Constructs perpendiculars, bisectors, specified angles and bisects angles using reflections.	160,162, 163,168	185-187	Gr.7 (C90, C91)
5.	Identifies and classifies polygons.		168	G4.7 (C31)
6.	Identifies pairs of angles: supplementary, complementary, corresponding, linear, opposite and adjacent.	145,149,150 169,170,171	155-165	G39
7.	Identifies and classifies quadrilaterals by examining relationships between: - lines of symmetry - parallel sides - measures of angles - measures of sides.	153,154 165	168,184	Gr.7 (C29, C29)

	TEXT REFERENCE		
Geometry (Continued)	*Math Is 2*	*Holt Math 2*	*School Math 2*
8. Generates an area formula for specified quadrilaterals (parall-elogram, rectangle, square).	68,78	55,56,57	G34
9. Uses slide notation to describe various translations (slides) 3R, 2D for 3 right and 2 down.		279 177-180	G4,G5
10. Describes translations using ordered pairs; eg. (+3, -2) for 3 to right, 2 down.	305-307	177-180	
11. Obtains the rotation image for any polygon.	310-312	276-278, 286	G6,G7

5. GRAPHING			
1. Generates a set of ordered pairs in a linear function given the defining equations.	114,118 125,126 130,131 238,239	248-252	E50,E51 E106,E107 F33
2. Graphs points of a linear function given ordered pairs of integers and notes that those points lie on a line.	130-134	248-258	E52-E55 E119,F33
3. Constructs circle graphs.	202,203,205	133,135,136 140,298,299 300	H40,H41

	TEXT REFERENCE		
6. ALGEBRA	*Math Is 2*	*Holt Math 2*	*School Math 2*
1. Evaluates expressions by substituting for the variables. (Using whole numbers, fractions, decimals, integers, and rationals.)	8-10	117,39,34	E34,E35,E37
2. Solves the following types of conditions (equations), in which the solution does not involve computation with negative fractional numbers. a. a + x = b b. ax = b c. ax + b = c d. $\frac{x}{a} = \frac{b}{c}$ e. ax + bx = c	9 259-265 278	243,244 35,36	E38-E45 E116,E117
3. Writes mathematical sentences for English sentences describing real life or abstract number relationships.	6,113,114 258-260	34-39	
4. Solves word problems involving abstract number relationships.	266-268 278	36,38	E46,E47

Grade 9

1. NUMBER SYSTEMS	TEXT REFERENCE		
A. WHOLE NUMBERS	Math Is 3	Holt Math 3	Math Probe 1
1. Writes the values for powers (whole number exponents).	8-12,28-31	52	16
2. Understands and uses the following properties: a. $(a^x)^y = a^{xy}$ b. $a^{-x} = \dfrac{1}{a^x}$ c. $a^o = 1, a \neq o$	230-236	53-63 213,214	17
3. Maintains previously developed skills in problem solving.	11,15,22 28-30,31 37-38	1	16
4. Expresses a number as a product of factors (including prime factorization).	10	48	21

B. INTEGERS

	Math Is 3	Holt Math 3	Math Probe 1
1. Maintains previously developed skills.	38-70	35,37-47 49-51	24-35
2. Simplifies expressions involving the order of operations (four arithmetic operations and powers).	64-66	8,9,80	11

C. RATIONALS

	Math Is 3	Holt Math 3	Math Probe 1
1. Maintains previously developed skills.	117-121, 125-128	6,7 11-33	48-50
2. Writes any number in scientific notation and vice-versa.	337	64,65	64-66
3. Recognizes a need for negative rationals.	117-124	66,67	48
4. Writes positive or negative rationals in lowest terms or higher terms.	106 117-121	68	

	TEXT REFERENCE		
Rationals (Continued)	Math Is 3	Holt Math 3	Math Probe 1
5. Adds, subtracts, multiplies and divides positive or negative rational numbers.	117-121 125-128	69-72	60-62
6. Changes positive or negative rationals in the form $\frac{a}{b}$, $b \neq 0$ to decimals.	133-135 384	67	56
7. Changes rational numbers in decimal form to the form $\frac{a}{b}$.	133-135	22,23 67	59
8. Solves problems involving positive and/or negative rationals (emphasis on decimals).	130,132, 135,152	73	112,113 71
9. Estimates products and quotients to determine if an answer is reasonable.	141-142 384	4,5 26,30	14-15
10. Estimates square roots of numbers.	141-142	84,85,91	80-85
11. Uses tables to determine the square root of a number.	142-143	83,92,93	86

2. RATIO AND PROPORTION			
1. Maintains previously developed skills.	194-198 323-324	139-145 148-156	
2. Uses ratios to solve problems involving: a. percentages b. distance, speed and time c. profit, interest, commission, tax, discount, premiums.	175-178 199-214	146-147 157-160 165	
3. Uses ratios to construct scale drawings.	353-354	282-287	

3. MEASUREMENT	TEXT REFERENCE		
	Math Is 3	Holt Math 3	Math Probe 1
1. Demonstrates that previous skills are maintained.	172-175 215-217 328-329	175-177 217	178-225 240-255
2. Calculates surface areas (SI units) of prisms and cylinders using formulas.	329-333	181-183 187,189,190	
3. Calculates the area of regular polygons.		178	

4. GEOMETRY			
1. Demonstrates that previous skills are being maintained.	286-287	168-171 195-197 277,291-298	178-194 204-214
2. Demonstrates knowledge of the Theorem of Pythagoras through an ability to solve problems.	147-149	94-100	86-90
3. Using compass and straight edge, constructs triangles congruent to given triangles, using SSS, SAS, and ASA.	317-318	200-202	224-228
4. Constructs regular polygons.		197	
5. Uses such terms as edges, faces, lateral face, base, height, slant height, in examining prisms, pyramids and other polyhedra.	329-333	181,185 191,192	
6. Classifies right prisms, right pyramids, given models of various types.		181,185	
7. Constructs models of right prisms, right pyramids or regular polyhedra as specified by teacher.		189,191	
8. Develops, with assistance, formulas to measure volume and surface area of right prisms and cylinders.	329-333	181-183 189	
9. Given word problems or diagrams and formulas, the student will solve volume and surface area problems.	328-336	179-180	254,255 258

5. GRAPHING	TEXT REFERENCE		
	Math Is 3	Holt Math 3	Math Probe 1
1. Makes graphs from mathematical data and recognizes the dependent variable and the relation constant (limited to linear relations).	111-116		163-165
2. Pictures square roots of numbers graphically and reads approximate roots of non-perfect squares from the graph.	141-142	74-79 133-135 310,311	

6. ALGEBRA			
1. Solves any first degree equation in one variable with rational coefficients.	160-168	107-117 125-126	18-19 100-110
2. Writes word problems for given mathematical statements.	158		
3. Solves a variety of problems by writing an equation in one variable and solving same.	169-185 202-212 215-217 224-226	242,249-258 264,266,272 273	111-114
4. Knows that letters represent variables.	12-19 23-32 34-38	10,11,175	37,98
5. Knows that formulas represent rules or definitions that express a relation between variables in mathematics and/or science.	15-17 218-219	121,122 175	37-38
6. Interprets mathematical data and can express it as a relationship (limited to linear relations using a non-formal approach).	34-38 67-70 109-110	309	
7. Applies mathematical principles of variation and formulas to real situations.	59-60,63 147-149,172 175,176-185 188-190,201-219	256,265 267,121	166-167 219
8. Predicts the effect of altering specific elements of a formula.	82-83,90,94 101,188-190	187,190	
9. Solves problems which require the use of a formula.	147-149,172 175-176-178, 190,202-209, 212-219	121,122,226 227,243-244 256	88,89,115
10. Identifies specific algebraic terminology; constants, variables, terms and factors in an expression.	12,75-78, 102,239, 255	207,208	126-

|		TEXT REFERENCE		
Algebra (Continued)		*Math Is 3*	*Holt Math 3*	*Math Probe 1*
11.	Evaluates expressions by performing the operations in correct order.	64-65 127-130	118-120	11
12.	Classifies polynomials as to monomial, binomial and trinomial.	75-77 80-82	207,208	126-129
13.	States the degree of a polynomial and writes the polynomial in standard form.	236-247	207,208	
14.	Translates English expressions into algebraic expressions.	78,79,82-83 86-87,90,97- 102,103-105, 130-132,157- 159,172-174,	212 249-250	43, 126-129
15.	Identifies the numerical coefficient of a monomial.	75-76 84-85	207,208	126-129
16.	Identifies "like" and "unlike" terms and is able to combine like terms.	75-83 98-99	209	
17.	Finds the sum and difference of polynomials by re-ordering the elements.	80-83 98-99 102-105	209-211 222,223 246	130-135
18.	Finds the products and quotients of monomials.	83-87 91-94	215,218 219,222,223 246	16-17 126-130
19.	Finds the product of a monomial and a polynomial.	88-90,95 98-99	215,216 222,223 246	138-139
20.	Factors a polynomial by taking out the greatest common factor.	255-260	228,229 230,246	146-148
21.	Finds the product of binomials.	236-253	224,225 247	145-146
22.	Factors trinomials ax^2+bx+c, where a=1.	263-266, 271-272	231-233 247	148-150

GRADE 9 ELECTIVES

Calculators (10-12 hours)

Hand held calculators (HHC) are becoming a part of our lives -- in our homes, work, and in our classrooms. They cannot be ignored but their best use in mathematics classes is not yet known.

There are at least three readily discernible strategies or points of emphasis that can define the use of HHC in the classroom. Firstly, the emphasis may be on the use of HHC as a computational device pure and simple. Secondly, the emphasis may be on the use of HHC as a device to be used in games and competitions. Finally, the emphasis may be on the use of HHC as a device to bring about understandings of mathematical concepts and generalizations. This elective is aimed at this last use.

The concepts and generalizations chosen are certainly not inclusive but are chosen as a sample to illustrate the possibilities.
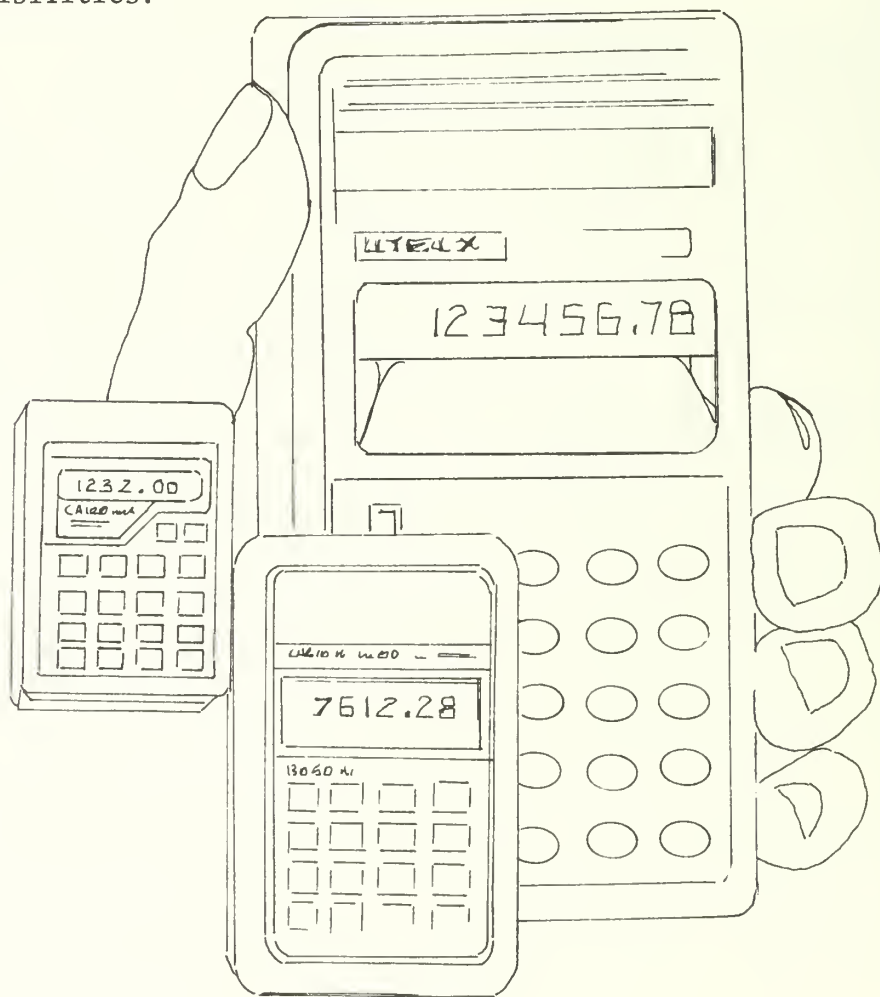
Materials

Ideally each student would purchase his own calculator and be responsible for it. Alternatively, a school could purchase a few calculators and still be able to have mathematics class units related to them.

Time Allotment

10 - 12 hours

Objectives   (Sample activities)

I   Exponents

A.   Increase computation and estimation skills
- example:
        72 345÷22   10 469÷63
        14 507÷612   17 467÷894
(Lends itself to a game format with the calculator used to check answers.)

B.   Increase skills in recognizing computational patterns.
- example:
        0.0105÷0.005 =
         0.105÷0.05   =
          1.05÷0.5   =
          10.5÷5   =
        10 500÷? _____ = 2.1
        ___?__ ÷50 000= 2.1

Conclusions?

C.   Discovers or recognizes power properties by generating patterns.

1. $x^a \times x^b = x^{a+b}$
     Examples: $3^4 \times 3^3 = 3^7$
                      $(-1/6)^4 \times (-1/6)^3 = (-1/6)^7$
                      $(0.02)^4 \times (0.02)^3 = (0.02)^7$
(Remember that there is no such thing as a "messy computation" when using a HHC.)

2. $x^a \div x^b = x^{a-b}$
          (similar to above)

3. $(x^a)^b = x^{ab}$
     Examples:
                $(3^2)^4 = 3^8$

                $((-1/6)^4)^3 = (-1/6)^{12}$

                $((0.02)^3)^2 = (0.02)^6$

4. $(xy)^a = x^a \cdot y^a$

    Examples:

$$(2 \times 3)^4 = 2^4 \times 3^4$$
$$((0.06)(-\tfrac{1}{4}))^4 = (0.06)^4(-\tfrac{1}{4})^4$$

5. $x^{-n} = \dfrac{1}{x^n}$

    Examples: $\quad (0.02)^{-2} = \dfrac{(0.02)^3}{(0.02)^5} = \dfrac{1}{(0.02)^2}$

$$(-2)^{-3} = \dfrac{1}{(-2)^3}$$

D.   Solves inequalities involving powers.

    Examples:

       Solves for x.

$$2^x > 100 \qquad\qquad 500 \leq \dfrac{1}{(0.03)^x}$$

$$0.3^x > 0.0001 \qquad 44\ 965 \leq \dfrac{1}{(0.3)^x}$$

E.   Develops skills in checking complex computations.

    Examples:

$$(3^{-2})^{-4} \times (3^{-1})^{-3}$$

$$3^8 \times 3^3 = 3^{11}$$

$$6^{-4} \times 3^{-4} = (6 \times 3)^{-4}$$

$$16x^2 \left(\dfrac{-3}{4x^2}\right) = -12 \quad \text{(Check by substituting x=0.003)}$$

F.   Develops skills in using scientific notation.

G.   Uses Newton's method of extracting square roots.

II.   Algebra

A.   Develops skills in evaluating expressions.

    Examples:

$$(6x + 9) - (x + 5) = 5x + 4 \quad \text{when x=1.03}$$

If one factor of $10e^2f$ is ef, the other factor is _____.
Check by letting $e = 14.3$ and $f = -4.2$.

Many algebraic sentences are generalizations that can be
checked by substitutions or even in some cases discovered
by substitutions.

B. Develop skills in finding relation rules.
   Examples:
            Find 4 ways of sending -2 to -5.
            $(-2)(3) + 1$ $(-2)(-2) - 9$
            $(-2)(4) + 3$ $(-2)(1) - 3$ etc.
   Which of these will send 4 to -7? Can you find a way of
   sending -2 to -5 and 4 to -7?

C. Develops skill in finding GFC's using the HHC.
   Example:
      $12z^4$, $72z^3$, $-12pz^2$ (Check by letting z = 0.03 and p = 142).

D. Develops skill in finding LCM's using the HHC.
   Example:
            Find the LCM of 16, 18, and 24.
            $16 \times 2 = 18 \times 1.\overline{7}$
            $16 \times 3 = 18 \times 2.\overline{6}$
            $16 \times 4 = 18 \times 3.\overline{5}$
                       $\downarrow$
                       $\downarrow$
            $16 \times 9 = 18 \times 8 = 144$ and $144 = 24 \times 6$
                       144 is the LCM of 16, 18 and 24.

E. Develops skill in finding prime factorizations using the HHC.
   Example:
            Find the prime factorization of 1084. Keep dividing
            the sequential quotients by 2 until an odd quotient
            is obtained. Repeat the process using 3, 5, 7, 11, etc.
            in sequence.
   Thus:

   $7644 = 2 \times 3822$
            $3822 = 2 \times 1911$
                     $1911 = 3 \times 637$
                              $637 = 7 \times 91$
                                       $91 = 13 \times 7$

   so that $7644 = 2 \times 2 \times 3 \times 7 \times 13$

III   Measurement and Geometry

   A. Develops skill in finding volumes of naturally occur
      objects. (Messy calculations are no hindrance).
   B. To find ratios of surface areas to volumes, leading to
      generalizations.
   C. To check area formulas by calculation, e.g. area of a
      triangle using the 3 bases and their corresponding altitudes.
   D. To develop problem-solving skills.
      Example:
               If a paper back book is 8.1 cm x 10.2 cm x 2.3 cm and
               contains 312 pages what is the volume of a single page?

IV   Percent and ratios.

     A.   Develops skills in calculating rates and comparing.
     B.   Develops comparison shopping skills from newspaper ads.

    Concluding remarks:

        This unit could be used to give students a review of
        previously covered material using a different format.

        Probably it would be ideal to use calculators within the
        core program on a fairly regular basis rather than as a
        separate unit.

        Much of our present curriculum is stilted because we want
        to avoid messy computations. Calculators free us from that
        constraint.

Consumerism (10 - 15 hours)

A very valuable application of mathematical skills can be made in a consumerism unit.

The purpose of the unit is to enable students to apply their mathematical skills in a variety of life-like situations which require wise handling of money. Percent problems involving money are typical real life problems which may be solved using math skills.

It is strongly recommended that students make use of calculators when required to perform computations.

The use of the hand calculator is encouraged for this unit.

I. Making Money

    A. Understands and computes wages earned on per hour basis.
        1. Given hourly wage - Computes day, month and yearly wage
        2. Overtime - computes time-and-a-half and double time

    B. Understands and calculates annual earnings based on a
        salary using both weekly and monthly salaries.

    C. Understands and calculates earnings based on commission.

    D. Understands and calculates wages earned by piece work.

    E. Understands and calculates earnings based on contract work.

    F. Has an understanding of compulsory deductions from earnings.
        1. Income Tax
        2. Canada Pension
        3. Unemployment Insurance

    G. Understands and calculates take-home pay.

II. Spending Money

    A. Calculates total prices when per unit weight or volume
        prices are supplied.

    B. Calculates per unit volume or weight prices thus calculating
        best buys.

    C. Understands and calculates cost, profit, mark-up, market
        and list price, sales and net price and rate of reduction.

    D. Calculates reduced price knowing list price and percent of
        reduction.

    E. Calculates cost of owning and operating automobile.
        1. Price including possible finance charges
        2. Registration and Insurance
        3. Depreciation
        4. Certain expenses (gas, oil, tires)
        5. Possible expenses (repairs - parts and labor)

F. Calculates the cost of buying a home on 10, 15, 20 or
    25 year mortgage, given amortization tables.

G. Understands and calculates the amount of interest on credit
    cards (eg. Chargex) knowing monthly interest.

H. Budgeting

    1. Given different sums of money as possible monthly allow-
        ances,the student creates budgets to meet his needs.

III. Savings and Investing Money

    A. The student understands the difference between a personal
        savings account, a savings-chequing account and a chequing
        account.

        1. Calculates yearly interest on a savings account using
            $I = prt$

        2. Calculates compound interest for terms up to five years
            when interest is compounded annually.

    B. The student develops a basic knowledge and understanding,
        the depth of this understanding determined by the teacher
        and the abilities of the class, of

        1. stocks
        2. bonds
        3. savings certificate

Resources for Consumer Option Unit - Grade 9

    Bye, Marshall, et al, *Holt Mathematics 3*, Holt, Rinehart and
        Winston of Toronto, 1978 - pages 157 - 165.

    Ebos, Frank, et al, *Math Is 3*, Thomas Nelson & Sons,
        Don Mills, Ontario, 1976 - pages 359 - 365.

The use of such community resources as field trips to local businesses,
guest speakers, newspapers, and other media is highly recommended for
this unit.

History of Mathematics (10-12 hours)

Mathematics is a series of patterns that have been discovered and recorded by man. This unit by the description of its suggested topics is intended to introduce students to areas seldom studied in school. Emphasis is on activity and involvement.
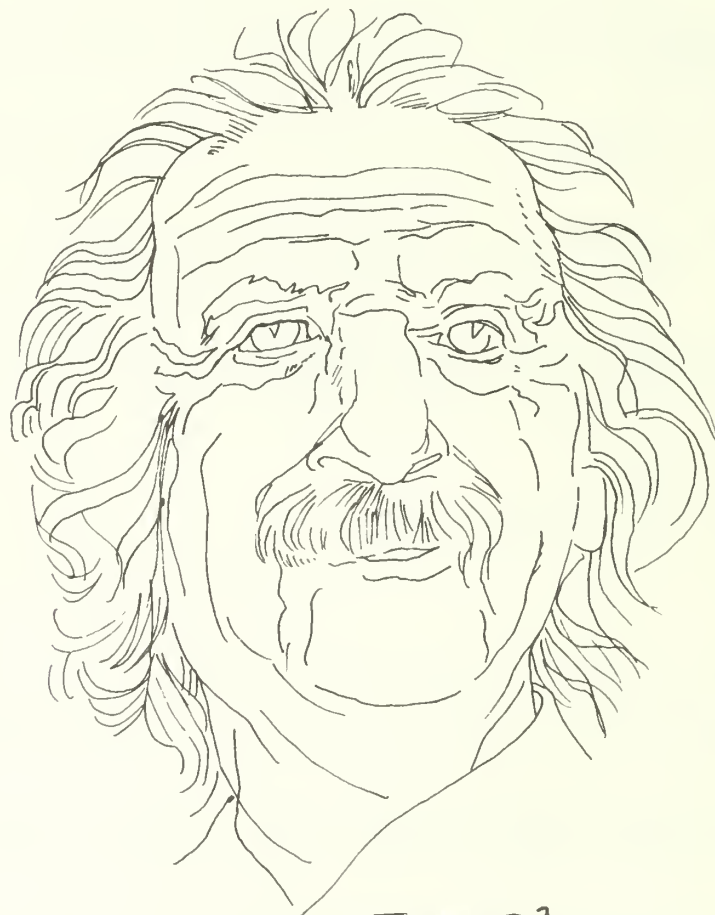
$$E = mc^2$$

1. Through study of the lives of mathematicians such as Gauss, Archimedes, Galois, Pythagoras, Euler and Descartes etc., the student will be able to see mathematics as a humane, living subject. (Students might write a skit to "relive" the life of Evariste Galois for example.

2. Prepares displays to trace the development of numeration from early man to our present Hindu-Arabic system including studies of Egyptian, Babylonian, Chinese, Roman and Mayan systems of counting.

3. Traces the development of calculators from simple devices such as Napier's Rods, calculators constructed by Pascal and Babbage, Binary Computers and Slide Rules. The student will construct a simple calculating device.

4. Using both intuition and more formal processes examines Number Theory resulting from:

    1. The Greeks and their work with figurate numbers
    2. Eratosthenes and his study of primes
    3. Various Theorems of Fermat.

5. Studies shape, design and geometry through examination of the work of various mathematicians such as:

    1. Albrecht Dürer and his use of geometry in art
    2. Maurits Escher and his development of tessellations and illusions through mathematics.
    3. The Greeks and their study of the Golden Section
    4. Thales and Egyptians and their use of knotted ropes in applications of geometry.

Resources for History

1. Many school libraries contain references to the above topics. Several in particular are:

    Bell, E. T., *Men of Mathematics*, Simon and Shuster, New York, 1966.

    Bergamini, David, *Mathematics*. Life Science Library. Time-Life Books, New York, 1963.

    Denholm, Richard A., *Mathematics: Man's Key to Progress* (Book A and B), Franklin Publications Inc., Chicago, 1970.

    Hogben, Lancelot, *The Wonderful World of Mathematics*, Doubleday and Company, New York, 1955.

2. The "Consortium Materials" published by *Junior High Consortium* contain references to the historical aspect of topics included in the basic core. See the Teacher's Resource Book.

3. Krysak et al, *Math Probe 1*, Holt Rinehart and Winston, 1975.

   This book contains references to the History of Mathematics along with projects for students. The references to History relate to the topics of study in the text.

Motion Geometry (10-15 hours)

Students have used motion geometry for several years, as a tool to investigate and discover properties of geometric figures. This option provides an opportunity to formalize many of the intuitively developed properties and theorems.

It is recommended that tracing paper, geometry sets, graph paper, mirrors and a Mira (colored plexiglass) are valuable aids to the teaching of this option.
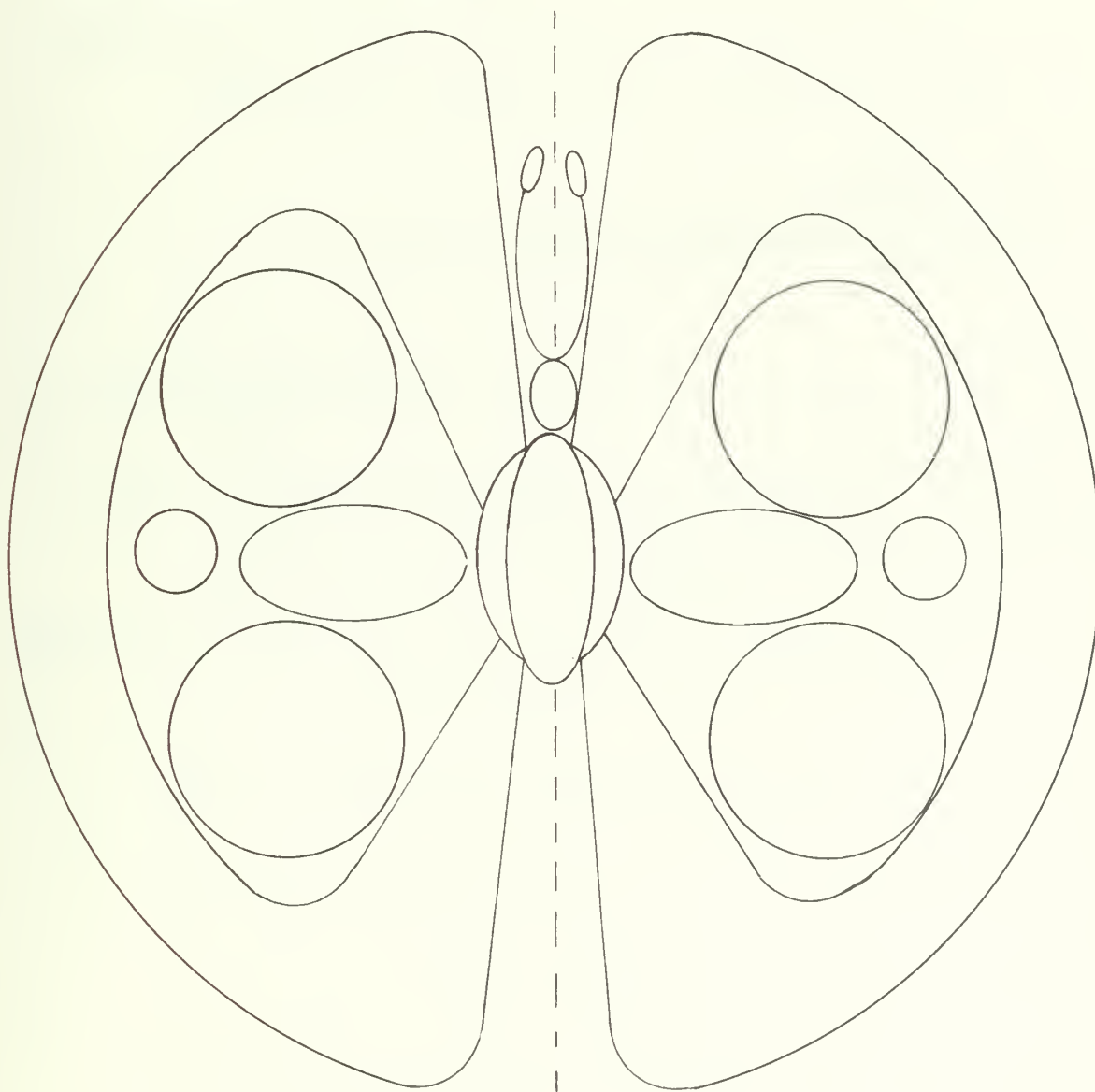
1. Uses a Mira to bisect angles, construct perpendiculars, bisectors, and specified angles.

2. Identifies and constructs figures which are size transformations of given figures.

3. Understands the concept of congruence with the aid of slides, rotations or reflections.

4. Relates slides, rotations and reflections to the coordinate plane.

5. Uses combinations of transformations to define images of figures.

6. States and illustrates the properties of a figure under:

    1. slides
    2. rotations
    3. reflections
    4. size transformations (see Notes, page 57)

Resources

Bye, M., et al, *Holt Math 3*, Holt, Rinehart and Winston, Toronto, 1978.

Ebos, F., et al, *Math Is 3*, Thomas Nelson and Sons, Don Mills, Ontario, 1976.

Del Grande, J., *Math Book 3*, W. J. Gage, Toronto, 1975.

Mira Math Company, *Mira Math for Junior High Schools*, P.O. Box 625, Station B, Willowdale, Ontario, M2K 2P9.

NOTES

1. Slide:

    - a translation is an isometry: figures map onto congruent figures.

    - a segment maps onto a congruent and parallel segment.

    - the segment's joining points and their images are congruent and parallel.

    - attitude and orientation are preserved.

2. Rotation:

    - a rotation is an isometry.

    - a point and its image are the same distance from the turn center.

    - if P rotates to Q and O is the turn center, then the measure of LPOQ is the same as the measure of the angle of rotation.

    - the turn center is the only fixed point.

    - under a half-turn:
        - a point, its image, and the turn center lie on the same straight line;
        - the turn center is the midpoint of the segment joining a point and its half-turn image;
        - a segment and its half-turn image are parallel and congruent.
        - attitude of the shape will change.


3. Reflection:

    - a reflection is an isometry.

    - the mirror line M is the perpendicular bisector of the segment joining a point P and its reflection image Q.

    - the mirror line passes through the point of intersection of a line and its image.

    - the mirror line M bisects the angle between a line and its image.

    - all the points on the mirror line are fixed under a reflection.

    - a reflection is determined by its mirror line or by a point and its image.

    - reflection reverses orientation.

4. Size transformation:

    - the order of vertices is preserved.

    - corresponding angles are congruent.

    - corresponding sides are parallel.

    - the image and the original figures are similar.

Probability (12 - 16 hours)

Probability is the science of predicting the outcome of some event. It is intended that this unit would present a variety of problems whose solutions would require the application of some systematic methods. Emphasis should be on drawing from real life situations. The suggested resources provide direction for an interesting study.
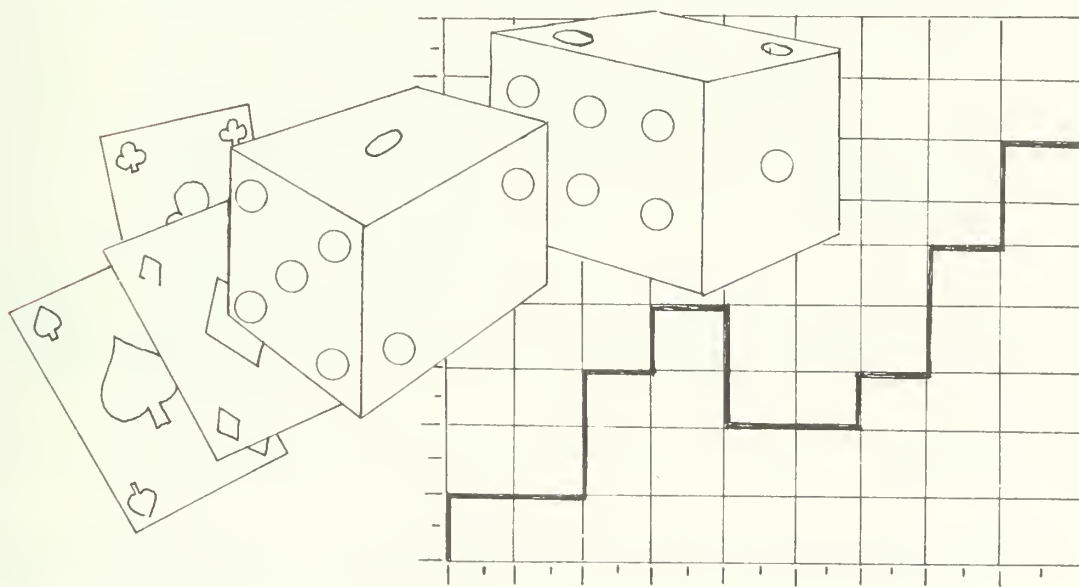
1. In a given experiment using dice or coins the student lists possible outcomes.

2. Makes charts and bar graphs of outcomes resulting from experiments.

3. Having performed an experiment or experiments to collect data the student predicts results of future similar investigations with degree of certainty.

4. Constructs a tree diagram to determine different arrangements in the solution of an appropriate problem.

5. The student will have facility with factorial notation and uses the Fundamental Counting Principal in calculating different arrangements (permutations).

6. Given situations, the student calculates theoretical probability of some event E:

$$P\ (E) = \frac{\text{number of favorable outcomes}}{\text{total possible outcomes}}$$

7. Calculates theoretical probability in events which are:
   a. independent
   b. dependent

8. Studies the life of Blaise Pascal and examines "Pascal's Triangle".

9. Examines appropriate problems to test the actual outcome against the theoretical outcome.

10. Examines for interest, situations and their probabilities as calculated.

    eg. - probabilities of certain card hands
        - probabilities of a family having eight girls born consecutively
        - probabilities that two persons in a room might have the same birthdate
        - chance that your General Motors car key will open another car from the same manufacturer.

Resources

Highly recommended for this unit is the text and teacher's guide.

Jacobs, Harold, *Mathematics: A Human Endeavour*,
    W. H. Freeman and Company, 1970, San Francisco

(The approach to Probability, Permutations, etc. is very imaginative and will create a high degree of interest. All topics are covered.)

Other resources include:

Bye, et al, *Holt Mathematics 3*, Holt, Rinehart and Winston, 1978 page 335-346.

Ebos, et al, *Math Is 3*, Thomas Nelson and Sons, 1976, page 375-379.

Ebos, et al, *Math Is 2*, Thomas Nelson and Sons, 1975, page 294-301.

Elliot et al, *Holt Mathematics 2*, Holt, Rinehart and Winston, 1976 page 205-213.

Fleenor, et al, *School Mathematics 2*, Addison Wesley, 1974, page H2-H26.

Problem Solving   (5-10 hours)

        This option is intended to be the application and synthesis of problem solving skills which have been developed in the regular mathematics program. The previous notes on problem solving are worth reviewing before this unit is undertaken.

        Students most likely to benefit from this unit are above average students with a high degree of responsibility. These two attributes are desirable due to the fact that direct teacher super-vision may not be available if other students are working on different topics or if data collection is necessary outside the classroom.
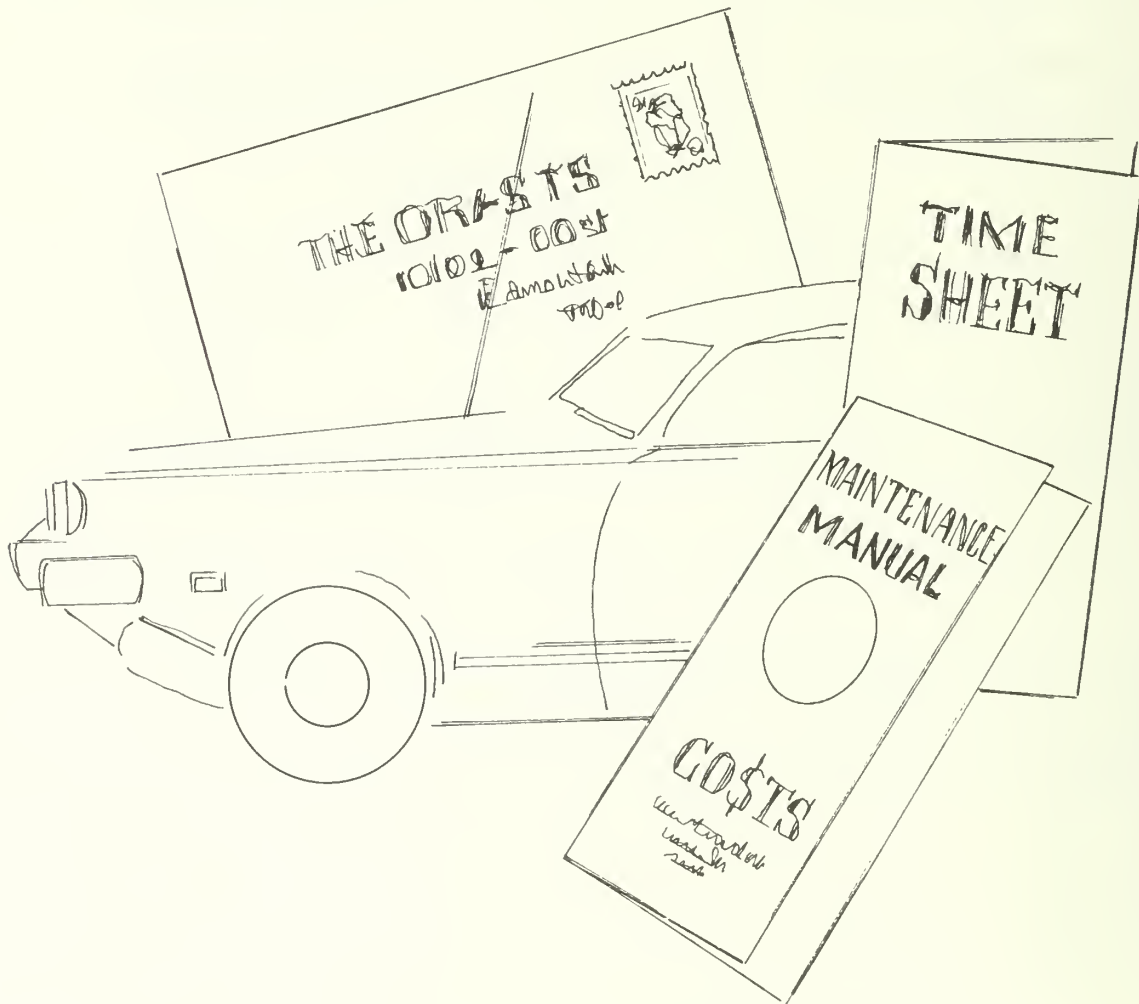
1. Identifies a problem in which extensive observation or research
    is required prior to attempting a solution. Examples:

    - How many pages should the school yearbook have and how many
      copies should be printed?
    - How many years should your father keep his car?
    - How much fertilizer should be used on a crop for best net return?
    - Does smoking affect everyone's heartbeat in the same manner?
    - What time interval should traffic lights be set at?
    - What is an average man? Woman?
    - What is the most efficient interval of time to schedule buses
      in your community?
    - How expensive would Saturday mail delivery be?

2. Determines what factors influence the problem.

3. Identifies the limitations of the study.

4. Collects and organizes data.

5. Formulates a hypothesis or guess.

6. Tests hypothesis through extended data gathering or other tests.

7. Summarizes the study and makes conclusion(s) if possible, in
    the form of a written report.

8. Discusses what action should be taken with respect to findings
    and/or the applications which may be made of the findings.

Statistics   (8 - 10 hours)

Students see, in newspapers, magazines and on television,
various types of statistical data which is used to make and illustrate
certain statements and relationships.

The students should be able to analyze this data correctly
and use it to make their own inferences. In order to do this they
should know how the information is gathered and organized. The
purpose or intent of this elective unit is to allow the students
a chance to experience working with numerical data to solve
certain types of problems and how the data can be used to distort
the fact.
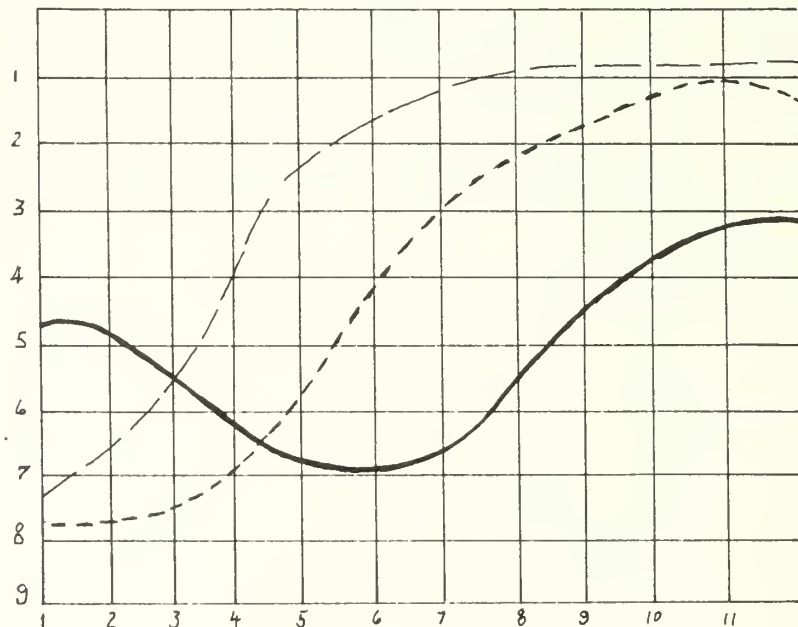
1. Knows the purpose and uses of statistics.

2. Reads and interprets information from a given set of data that is in the form of a table or graph.

3. Organizes a set of data into a table or chart form (frequency distribution).

4. Illustrates the data by means of a histogram or line graph.

5. Determines, from a set of data, the following measures of central tendency: mean, mode, medium and range.

6. Learns some instances of misuse of statistics.

7. Given a problem, understands how to collect data for the problem, organize the data and interpret the data.

   eg. How many hours a week do the students in your class watch television?

Resources

   Ebos, Frank, et al, *Math Is 2*, Don Mills: Thomas Nelson & Sons, 1975.

   Ebos, Frank, et al, *Math Is 3*, Don Mills: Thomas Nelson & Sons, 1976.

   *Elliott, H. A., et al, *Holt Mathematics 3*, Toronto: Holt, Rinehart & Winston, 1978

   *This is a very good reference.